

**SEVENTEENTH  
SUMMER  
RESEARCH  
SCHOOL**

in Mathematics and Informatics

**PROGRAM AND ABSTRACTS**



**July 30 – August 19, 2017**

**Blagoevgrad**

**High School Student Institute  
of Mathematics and Informatics**



# TABLE OF CONTENTS

Program.....	3
Lecture Abstracts .....	9
Program – Teachers’ Workshop .....	17
Abstracts of Teachers’ Workshop Talks .....	18
SRS'17 Participants .....	21



# SEVENTEENTH

# SUMMER RESEARCH SCHOOL

## IN MATHEMATICS AND INFORMATICS

July 30 – August 19, 2017, AUBG, Blagoevgrad, Bulgaria

# SRS'17

---

## PROGRAM

The Program will be available also as a *Google Calendar*. You can add it to your personal *Google Calendar*, if you have any.

**Legend** (please see also the map on the back cover):

BAC = Balkanski Academic Center; all lectures will be held here

AFBSC = America for Bulgaria Student Center

Scapto 1 = Scaptopara 1 Residence Hall

**MAT** This lecture is appropriate and mandatory for math students. It may be attended by IIT students.

**IIT** This lecture is appropriate and mandatory for informatics and IT students. It may be attended by math students.

**ALL** This lecture is appropriate and mandatory for all students.

All students can attend also the Teachers' Workshop.

Any other events in the Program are mandatory for all students except with the prior permission of the Commandant or your Counselor.

### **July 30, 2017, Sunday**

*Arrival and accommodation at the campus of the American University in Bulgaria, Scaptopara 1 Residence Hall*

**14:00 – 19:00** Registration in the lobby of Scapto 1 Residence Hall

**19:00 – 20:00** Dinner (AFBSC, 3<sup>rd</sup> floor)

**20:00 – 21:00** Kick-off meeting (AFBSC, 3<sup>rd</sup> floor)

### July 31, 2017, Monday

- 08:00 – 09:00** Breakfast
- 09:00 – 10:30** Placement of assignments (BAC)
- 11:00 – 12:00** Opening Ceremony (Blagoevgrad Municipality Hall, 1, Georgi Izmirliiev Sq.)
- 12:30 – 13:00** Group Photo (in front of BAC)
- 13:00 – 14:00** Lunch
- 14:00 – 19:00** Placement of assignments (BAC)
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Ice breaking games
- 22:00 – 23:00** Check-in (Scapto 1 lobby)

### August 1, 2017, Tuesday

- 08:00 – 09:00** Breakfast
- 09:00 – 11:00** **MAT** Emil Kolev, *Combinatorial Games*
- 11:00 – 13:00** **ALL** Yanitsa Pehova, *Typesetting in LaTeX*
- 13:00 – 14:00** Lunch
- 14:00 – 19:00** Individual work, meetings with mentors
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Ice breaking games
- 22:00 – 23:00** Check-in (Scapto 1 lobby)

### August 2, 2017, Wednesday

- 08:00 – 09:00** Breakfast
- 09:00 – 11:00** **ALL** Zlatogor Minchev, *Analytical Challenges to Digital Future Securing*
- 11:00 – 13:00** **MAT** Yanitsa Pehova, *Topics and Techniques in Graph Theory*
- 13:00 – 14:00** Lunch
- 14:00 – 16:00** **ALL** Stanislav Harizanov, *Digital Image Processing*
- 16:00 – 19:00** Individual work, meetings with mentors
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 23:00** Check-in

### August 3, 2017, Thursday

- 08:00 – 09:00** Breakfast  
**09:00 – 10:00** **MAT** Vasil Vasilev, *Cyclotomic Polynomials and Their Applications in Contest Problems. Zsigmondy Theorem*  
**10:00 – 13:00** **IIT** Yavor Papazov, *Introduction to Information Security*  
**13:00 – 14:00** Lunch  
**14:00 – 16:00** **IIT** Yavor Papazov, *“Sustainable“ programming practices*  
**16:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 22:00** Sports tournaments and free time  
**22:00 – 23:00** Check-in

### August 4, 2017, Friday

- 08:00 – 09:00** Breakfast  
**09:00 – 11:00** **ALL** Todor Kolev, *How the Exponential Technologies Shape Our Future*  
**11:00 – 13:00** **MAT** Peter Gaydarov, *Random Processes*  
**13:00 – 14:00** Lunch  
**14:00 – 16:00** **IIT** Alexander Targov, *Block Chain and Bitcoin Fundamentals*  
**16:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 23:00** Quiz  
**23:00 – 24:00** Check-in

### August 5, 2017, Saturday

- 08:00 – 09:00** Breakfast  
**09:00 – 13:00** Individual work, meetings with mentors  
**13:00 – 14:00** Lunch  
**14:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 23:00** Barbecue Evening at the backyard of Scapto 1  
**23:00 – 24:00** Check-in

### August 6, 2017, Sunday

- 08:00 – 09:00** Breakfast
- 09:00 – 19:00** Trip to Bansko and Pirin
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Free time
- 22:00 – 23:00** Check-in

### August 7, 2017, Monday

- 08:00 – 09:00** Breakfast
- 09:00 – 13:00** Individual work, meetings with mentors
- 13:00 – 14:00** Lunch
- 14:00 – 19:00** Individual work, meetings with mentors
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 24:00** Astro Night 1 – Teodor Alexiev, Simona Hristova,  
*Introduction to coordinate systems in astronomy  
and explanation of different orbit types*

### August 8, 2017, Tuesday

- 08:00 – 09:00** Breakfast
- 09:00 – 11:00** **ALL** Emil Kelevedjiev, *Linear Programming and Applications 1*
- 11:00 – 13:00** **MAT** Melania Berbatova, *What is the probability...?*
- 13:00 – 14:00** Lunch
- 14:00 – 16:00** **ALL** Emil Kelevedjiev, *Linear Programming and Applications 2*
- 16:00 – 19:00** Individual work, meetings with mentors
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 24:00** Astro Night 2 – Teodor Alexiev, Simona Hristova,  
*Star clusters and Variable stars*

### August 9, 2017, Wednesday – August 10, 2017, Thursday

- 08:00 – 09:00** Breakfast
- 09:00 – 13:00** Individual work, meetings with mentors
- 13:00 – 14:00** Lunch
- 14:00 – 19:00** Individual work, meetings with mentors
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 23:00** Check-in



### **August 11, 2017, Friday**

**08:00 – 09:00** Breakfast  
**09:00 – 13:00** Individual work, meetings with mentors  
**13:00 – 14:00** Lunch  
**14:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 23:00** Talent Show  
**23:00 – 24:00** Check-in

### **August 12, 2017, Saturday**

**08:00 – 09:00** Breakfast  
**09:00 – 13:00** Individual work, meetings with mentors  
**13:00 – 14:00** Lunch  
**14:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 23:00** Movie Night  
**23:00 – 24:00** Check-in

### **August 13, 2017, Sunday**

**08:00 – 09:00** Breakfast  
**09:00 – 13:00** Individual work, meetings with mentors  
**13:00 – 14:00** Lunch  
**14:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 23:00** Culture Night  
**23:00 – 24:00** Check-in

### **August 14, 2017, Monday**

**08:00 – 09:00** Breakfast  
**09:00 – 13:00** Individual work, meetings with mentors  
**13:00 – 14:00** Lunch  
**14:00 – 19:00** Individual work, meetings with mentors  
**19:00 – 20:00** Dinner  
**20:00 – 23:00** Sports tournaments and free time  
**23:00 – 24:00** Check-in

**August 15, 2017, Tuesday**

- 08:00 – 09:00** Breakfast
- 09:00 – 13:00** Individual work, meetings with mentors
- 13:00 – 14:00** Lunch
- 14:00 – 19:00** Individual work, meetings with mentors
- Arrival and registration of teachers for the Teachers Workshop*
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 23:00** Check-in

**August 16, 2017, Wednesday – August 17, 2017, Thursday**

- 08:00 – 09:00** Breakfast
- 09:00 – 13:00** Students' presentations
- 13:00 – 14:00** Lunch
- 14:00 – 18:00** Teachers Workshop, see Page 17 for the Teachers' Workshop Program
- 19:00 – 20:00** Dinner
- 20:00 – 22:00** Sports tournaments and free time
- 22:00 – 23:00** Check-in

**August 18, 2017, Friday**

- 08:00 – 09:00** Breakfast
- 09:00 – 13:00** Students' presentations
- 13:00 – 14:00** Lunch
- 14:00 – 15:00** Galina Staneva, The Bulgarian Participation at S'Cool LAB Summer Camp in CERN
- 15:00 – 18:00** Tanya Otsetarova, Ivan D. Ivanov, Evgenia Sendova, Presentations of the Bulgarian RSI'17 Participants
- 19:00 – 19:30** Dinner
- 19:30 – 23:00** Closing and Farewell Ceremony with Dances

**August 19, 2017, Saturday**

- 08:00 – 09:00** Breakfast
  - 09:00 – 12:00** Departure
-

# LECTURE ABSTRACTS

## **Block Chain and Bitcoin Fundamentals**

*Alexander Targov,  
Technical University of Sofia, Bulgaria  
alextargov@gmail.com*

Ever heard of 'blockchain'? Maybe not, but you have definitely heard of 'bitcoins'. In this lecture we are going to talk about what does a 'blockchain' mean, how is it related with bitcoins and will the blockchain technology transform the Internet and the global economy.

## **Micro:bit and What We Can Learn from It\***

*Angel Georgiev,  
Software University, Sofia, Bulgaria  
angel@softuni.bg*

The lecture will cover what the Micro:bit educational board can teach students and teachers about programming and how we can implement the knowledge in our daily lives. The lecture will consist of two parts. The first part will explain all the features and functionalities of the board. During the second part, the participants will get their own board and experiment with it.

\* This talk will be presented at the Teachers' Workshop but it is highly appropriate for students too, see Page 17.

## **Linear Programming and Applications**

*Emil Kelevedjiev,  
Institute of Mathematics and Informatics – BAS, Sofia, Bulgaria  
keleved@math.bas.bg*

Since the middle of the 20th century, mathematical modeling by means of optimization problems has been widespread in scientific applications. Together with the software developed, it has a real impact on practice, thus changing the ideas of society about the role of mathematics, computer science, and information technologies.

The lecture is aimed to show the accessibility of some basic notions and methods of linear programming and integer linear programming to the high school students. The mathematical

background of linear programming is exposed. Besides classical applications, some almost unknown methods for solving mathematical problems are discussed. Among the examples are recreational problems helpful for building connections between mathematics and the humanities. Free software, appropriate for the considered problems is also introduced: it can be used separately or in combination with elementary program codes.

### **Combinatorial Games**

*Emil Kolev,*

*Institute of Mathematics and Informatics – BAS, Sofia, Bulgaria  
emil@math.bas.bg*

Combinatorial games are one of the most exploited topics in competitive mathematics. One typical example of such problem is given below.

*Main problem.* We have two piles of coins having  $m$  and  $n$  coins, respectively. Two players A and B make moves and alternate each other. On each move the player takes  $x$  coins from one of the piles and adds  $y$  coins to the other pile ( $x$  and  $y$  can be changed on each move). Moreover,  $x \in X$  and  $y \in Y$ , where  $X$  and  $Y$  are given nonempty sets of non-negative integers. The player, who cannot make a move, loses the game.

By choosing different sets  $X$  and  $Y$ , one obtains great variety of problems. The main goal of the lecture is to describe an algorithm for solving the above problem (depending on  $m$ ,  $n$ ,  $X$  and  $Y$ ). The connection with other similar problems is also discussed.

### **What is the Probability...?**

*Melania Berbatova,*

*Faculty of Mathematics and Informatics, Sofia University, Bulgaria  
melania.berbatova@gmail.com*

Probability is the measure of the likelihood that the event will occur. It is used widely in areas such as Mathematics, Statistics, Finance, Computer Science, and Artificial Intelligence. During this lecture we will cover significant concepts of probability theory such as basic probability, probability trees, conditional probability, and we will dive into more advanced topics such as Bayes's theorem and geometrical probability. We will explore all this topics by real-world examples and mathematical problems. Brace yourself – The fastest wins!

## **Random Processes**

*Peter Gaydarov,*

*St. John's College, University of Cambridge, U.K.*

*peter.gaydarov@gmail.com*

The passing of time plays an essential part in the world which we inhabit, and consequently many applications of probability involve quantities which develop randomly as time passes. Such randomly evolving processes are called random processes or stochastic processes, and there are many different types of these. Most real processes in nature, such as the pollen count in Phoenix or the position of Swansea City in the football league, develop according to rules which are too complicated to describe exactly, and good probabilistic models for these processes can be very complicated indeed. We shall stick to some of the simplest random processes, and the specific processes which we shall consider in some depth are (a) Branching Processes: modelling the growth of a self-reproducing population (such as mankind), (b) Random Walks: modelling the movement of a particle which moves erratically within a medium (a dust particle in the atmosphere, say), (c) A stochastic process with the 'Markov property' i.e., conditional on its present value, its future is independent of its past. This is a very restrictive assumption, but it has two benefits. First, many processes in nature may be thus modelled, and secondly, the mathematical theory of such processes is strikingly beautiful and complete.

There is a fairly complete theory of each of these three types of process. In contrast, the general theory of stochastic processes is much more challenging. At one extreme, probabilists study 'concrete' processes such as the first two above, often designed to meet the needs of a particular application area, and at the other extreme there is an abstract theory of 'general' stochastic processes. Any tension between these two extremes is resolved through the identification of key properties which are shared by large families of processes and yet are sufficiently specific to allow the development of a useful theory. Probably the most important such property is the so-called 'Markov property'.

## **Digital Image Processing**

*Stanislav Harizanov,*

*Institute of Mathematics and Informatics – BAS, Institute of  
Information and Communication Technology – BAS, Sofia Bulgaria  
sharizanov@gmail.com*

Image processing is a modern and extremely active scientific field that combines research techniques from mathematics and informatics. Technological progress and the everlasting striving for improving the product quality (in this particular case – the quality of the input image) are the driving forces for the vast and permanent development of this field. New, modernly equipped computer laboratories have been built up solely for the purposes of image analysis. The obtained scientific results are applicable to a broad class of daily life activities, such as: medicine, engineering, national security, photography, material sciences, production quality control, nondestructive testing, archeology, architecture and many others.

In this introductory talk, we will explain the main problems in the field and will show various approaches how to handle them. The goal is to optimally reconstruct the true digital image based on the imperfect input image we are given, generated by a data acquisition device, such as scanner, digital camera, mobile phone, etc.

## **Introduction to Coordinate Systems in Astronomy and Explanation of Different Orbit Types**

*Teodor Alexiev\*, Simona Hristova\*\*,*

*\*Sofia Mathematical High School, Sofia, Bulgaria*

*\*\* Rouse Mathematical High School, Rouse Bulgaria*

*\* alexsiev.teodor@yahoo.com, \*\* s.hristova@yahoo.com*

In this present lecture we will define what horizontal and equatorial coordinate systems are. Also, we will show what some specific uses of both coordinate systems. By using a telescope, we will try to spot the first Bulgarian communication satellite – BulgariaSat-1.

## **Star clusters and Variable stars**

*Teodor Alexiev\*, Simona Hristova\*\*,*

*\*Sofia Mathematical High School, Sofia, Bulgaria*

*\*\* Rouse Mathematical High School, Rouse Bulgaria*

*\* aleksiev.teodor@yahoo.com, \*\* s.hristova@yahoo.com*

In the present lecture we will describe what a star cluster is and what are the main types of clusters in astronomy. Also what are variable stars and why are they important for our understanding of how the Universe works. Using the telescope everyone will be able to observe and distinguish the two main types of clusters. (Some of them are visible with a naked eye) Furthermore few binary star systems will be shown and explained.

## **How the Exponential Technologies Shape Our Future**

*Todor Kolev, Obecto Ltd., Sofia, Bulgaria*

*todor@obecto.com*

The exponentially growing technologies are changing every aspect of our lives and our jobs cannot stay unaffected. With AI and automation taking more and more of the human tasks, we are facing a not so distant future where “working for a living” might become obsolete. These are just some of the questions that we are going to discuss:

- What will be the professions of tomorrow?
- What will we do if machines are doing “everything” themselves?
- How the companies of tomorrow will get organized?
- What are the fundamental driving forces behind these processes?
- How will the world look like in 10 years?

## **Cyclotomic Polynomials and Their Applications in Contest Problems. Zsigmondy Theorem**

*Vasil Vasilev, Faculty of Mathematics and Informatics,*

*Sofia University*

*vassil.vassilev7@gmail.com*

Zsigmondy’s Theorem is one of much interest and very powerful applications in number theory. Some of its more interesting implementations are in literally destroying some otherwise very hard olympiad problems and solving the equation  $a^n = b^n + c^k$  in integers  $a$ ;  $b$  and  $c$  and natural  $n$ ;  $k$  for some special cases. Although they are part of university mathematics, we notice that cyclotomic polynomials are becoming more and more applicable in solving high school olympiad problems. We will begin with some basic properties of

cyclotomic polynomials and then review some of their applications in olympiad number theory. After that we will use them to prove the gigantic Zsigmondy Theorem. We will view some of the theorem's immediate inquests and continue with its applications in contest problems. After that we will take a closer look at the equation  $a^n = b^n + c^k$ , where  $a$ ;  $b$  and  $c$  are integers and  $n$ ;  $k$  are natural numbers. We will solve it for  $|c| \leq n$  and will discuss some approaches for further development.

### **Typesetting in LaTeX**

*Yanitsa Pehova,*  
*University of Warwick, Coventry, U.K.*  
*y.pehova@warwick.ac.uk*

LaTeX is a typesetting system used in most mathematical books and journals, and SRS is a great place to start learning it. We will start with the basics, using the online editor *ShareLatex*, writing a simple mathematical document from scratch, as well as looking at a few resources for further study.

### **Topics and Techniques in Graph Theory**

*Yanitsa Pehova,*  
*University of Warwick, Coventry, U.K.*  
*y.pehova@warwick.ac.uk*

We will cover a few central topics in the study of graph theory:

- *Introduction to graphs and examples.* What is a graph, what are some famous graphs called, etc. (boring part);
- *Ramsey's theorem and maybe infinite Ramsey's theorem.* One of the up and coming areas of combinatorics research is Ramsey theory. The classical Ramsey problem is the following: given  $k \in \mathbb{N}$ , does there exist a finite number  $N(k)$  such that any red/blue colouring of the complete graph on  $N$  vertices has a monochromatic copy of the complete graph on  $k$  vertices? We will prove a theorem which answers this question using an inductive approach.;
- *Dirac's theorem on Hamilton cycles.* This theorem states that every graph on  $n$  vertices with minimum degree at least  $n/2$  has a Hamilton cycle. It's not the most state-of-the-art result in the area, but the proof is quite interesting and shows common techniques used in graph theory even today.;
- *Turan's theorem.* This is what we call "extremal graph theory". Given a graph  $H$ , we ask what is the maximal number of edges a



graph not containing a copy of  $H$  can have (if you think this question is nonsense, it's because it isn't stated precisely). We will go through the statement and proof of the famous theorem of Turan answering this question for  $H$  being complete.

## **Introduction to Information Security**

*Yavor Papazov,  
European Software Institute – Center Eastern Europe, Sofia,  
Bulgaria  
yavorpap@gmail.com*

This lecture will cover the very basics of several topics in the field of Information Security, among them Network security, OS and Application security, Digital forensics, and a pinch of cryptography.

The first part of the talk will introduce the idea of information security as a field of science, its core tenets – the ‘pillars’ of InfoSec, discuss some of its real-world applications, define basic concepts such as ‘trust boundary’, ‘threat’, ‘risk’, ‘attack vector’ and ‘threat model’, while also highlighting the ‘ethical hacker’ concept and the legal and moral responsibilities professionals in the field have.

The second part of the lecture will define a basic taxonomy of the field and present basic results, methods and tools in selected important and developing niches of the InfoSec science. Among the topics will be Web security, Mobile security, Host security (Windows/Linux).

The last part of the lecture will essentially be a demonstration of real-world work in the field. The particular problem to be attacked will be selected based on the preference of the students present, but may include network forensics, host forensics, data forensics, network or web attacks or reverse-engineering.

## **“Sustainable” programming practices**

*European Software Institute – Center Eastern Europe, Sofia,  
Bulgaria  
yavorpap@gmail.com*

This lecture will focus on the steps, necessary to guarantee a “sustainable” process of writing code that allows completing programming projects in a sane and organized manner.

Particular areas of discussion will be the importance and basic usage of version control, practical concerns (which SCM to use, what to commit and what not), some management and process tips (setting

goals, defining requirements, splitting the project in tasks, project tracking), the absolute basics of virtualization and “DevOps” and how to “code” the specialized environment required to run the project.

## **Analytical Challenges to Digital Future Securing**

*Zlatogor Minchev,*

*Institute of Mathematics and Informatics – BAS, Institute of  
Information and Communication Technology – BAS, Sofia Bulgaria  
zlatogor.minchev@gmail.com*

Today's and tomorrow's smart world is inevitably changing our horizon and lifestyle, producing new opportunities and threats to modern and future socio-technological security landscape. This, from one hand, is directly related to new disruptive challenges like: smart devices, smart environment of living, smart software and cloud services in the innovative social multimedia interactive web and from another – to growing generation successful adaptation or misunderstanding of the new transcending cyber-physical ecosystem of living. The innovative technological solutions are also progressing from interface perspective, establishing a more natural human-machine dual communication, based on avatars, AI solutions and embedded bio-implants, involved into the new transformed multiple realities. Apart of these, trading and everyday life services are exponentially growing the necessities for flexible and global, user-oriented digital economy that requires a suitable computational power, progressing in the quantum computing context outreach. The exploration of the outlined complex digital landscape from a security perspective is impossible without an adequate hybrid approach that will be presented, in brief, in the lecture, sharing multiple successful research achievements. The implemented ideas incorporate expert knowledge, reference data, modelling, analysis and machine simulations that are finally verified through an interactive gaming with human-in-the-loop active role. The considered achievements are expected to provide a proactive analytical added value to the proper experimental studying of the upcoming digital future securing.

# PROGRAM

## Teachers' Workshop

**Legend** (see also the map on the back cover):

BAC = Balkanski Academic Center

AFBSC = America for Bulgaria Student Center

Scapto 1 = Scaptopara 1 Residence Hall

### August 15, 2017, Tuesday

**14:00 – 19:00** Arrival and registration of teachers (Scapto 1 lobby)

**19:00 – 20:00** Dinner (AFBSC, 3<sup>rd</sup> floor)

### August 16, 2017, Wednesday

**08:00 – 09:00** Breakfast

**09:00 – 13:00** Students' presentations (BAC)

**13:00 – 14:00** Lunch

**14:00 – 15:45** Angel Georgiev, *Micro:bit and What Can We Learn from It*

**16:00 – 17:00** Evgenia “Jenny” Sendova, *Variation on the Beauty of Mathematics and How to Convey It to Others*

**17:00 – 18:00** Petar Kenderov, Toni Chehlarova, *Models for Solving Real Life Problems*

**19:00 – 20:00** Dinner

### August 17, 2017, Thursday

**08:00 – 09:00** Breakfast

**09:00 – 13:00** Students' presentations

**13:00 – 14:00** Lunch

**14:00 – 14:40** Romyana Angelova, *Binary Lessons in Mathematics Education*

**14:40 – 15:20** Eleonora Pavlova, *How to Create Successful Teams*

**15:20 – 16:00** Steliana Kokinova, *Geometry in Algebra*

**16:00 – 16:30** Break

**16:30 – 17:10** Liliana Rusenova, *Opportunities in Vocational Education in IT*

**17:10 – 18:30** Round Table

**19:00 – 20:00** Dinner

### August 18, 2017, Friday

- 08:00 – 09:00** Breakfast  
**09:00 – 13:00** Students' presentations  
**13:00 – 14:00** Lunch  
**14:00 – 15:00** Galina Staneva, The Bulgarian Participation at S'Cool LAB Summer Camp in CERN  
**15:00 – 18:00** Tanya Otsetarova, Ivan D. Ivanov, Evgenia Sendova, Presentations of the Bulgarian RSI'17 Participants  
**19:00 – 19:30** Dinner  
**19:30 – 23:00** Closing and Farewell Ceremony with Dances

### August 19, 2017, Saturday

- 08:00 – 09:00** Breakfast  
**09:00 – 12:00** Departure

---

# **ABSTRACTS**

## **Teachers' Workshop**

### **Micro:bit and What We Can Learn from It**

*Angel Georgiev,  
Software University, Sofia, Bulgaria  
angel@softuni.bg*

The lecture will cover what the Micro:bit educational board can teach students and teachers about programming and how we can implement the knowledge in our daily lives. The lecture will consist of two parts. The first part will explain all the features and functionalities of the board. During the second part, the participants will get their own board and experiment with it.

## **How to Create Successful Teams**

*Eleonora Pavlova,  
Mathematical High School, Varna, Bulgaria  
eleonora.pavlova@gmail.com*

The result of working on a project is defined to great extent by the group chemistry. The advisor's role is a key to the establishment of respectful and supportive relationships among the team. In this work we will try to answer the question "What makes a team a successful one?" We will present contemporary techniques of developing students' skills for giving positive feedback and creating their own opinion, we will consider also some tools for group project management and monitoring.

## **Variation on the Beauty of Mathematics and How to Convey It to Others**

*Evgenia Sendova,  
Institute of Mathematics and Informatics – BAS, Sofia, Bulgaria  
jenny.sendova@gmail.com*

The art of seeing the beauty around us with mathematical eyes will be discussed in various context.

The focus will be on communicating the main ideas and outputs of one's own research project to peers, experts in the field, and to a larger audience. Examples of how to and how not to present orally and in written form will be given based on the speaker's experience as a tutor the Research Science Institute, an international summer program for high school students, organised jointly by CEE and MIT for more than 30 years..

## **Opportunities in Vocational Education in IT**

*Liliana Rusenova,  
Mathematical High School, Plovdiv, Bulgaria  
lylymo@abv.bg*

The evaluation criteria for projects submitted to different IT competitions are different. Some of them focus on the research approach, others are technologically targeted. This report will present some opportunities used in student`s projects preparation.

We will present several projects built with modern IT, based on practical tasks implemented as software products in several companies.

## **Models for Solving Real Life Problems**

*Petar Kenderov, Toni Chehlarova*

*Institute of Mathematics and Informatics – BAS, Sofia, Bulgaria*

Real-life problems that are considered at school nowadays, lead to a mathematical model which can be solved using the knowledge acquired by the students from the relevant age group. However, this limits the types of problems that can be solved and leaves the impression that mathematics is not applicable or useful enough. We give some examples of real-life problems which cannot be solved by using school-level mathematics but can be solved (at least to a certain degree of accuracy) by using specialized software.

## **Binary Lessons in Mathematics Education**

*Rumyana Angelova,*

*High School of Economics and Management, Pazardzhik,*

*Institute of Mathematics and Informatics – BAS, Sofia, Bulgaria*

This work is an attempt to share our vision on having binary lessons at school. The necessity of such classes is justified, various stages of organization and carrying out are considered, a model of a binary lesson is developed. Given are examples of binary lessons used in mathematics education.

## **Geometry in Algebra**

*Steliana Kokinova,*

*First English Language School, Sofia, Bulgaria*

*skokinova@abv.bg*

We will consider a system of three equations of second degree with three variables and we will use one of the classical theorems of geometry – the cosine theorem. The idea is further developed, using a 3D model in GeoGebra to find the solution.

---

# SRS'17 PARTICIPANTS

## STUDENTS

Aleksandar Nedkov, Sofia, Bulgaria, al\_nedkov@abv.bg

Alex Tsvetanov, Sofia, Bulgaria, alex\_tsvetanov\_2002@abv.bg

Ana Velichkova, Sofia, Bulgaria, ana.velichkova@gmail.com

Antoan Georgiev, Montana, Bulgaria, toto010@abv.bg

Antonio Eugenio, Foggia, Italy, antonio.eu@virgilio.it

Chavdar Lalov, Pleven, Bulgaria, chavdar.lalov@gmail.com

Cuong Veit Do, Sofia, Bulgaria, do.viet.cuong02@gmail.com

Dimitar Chakarov, Plovdiv, Bulgaria, dimitar.a4@gmail.com

Dimo Chaney, Sofia, Bulgaria, d1m.xpro@gmail.com

Dylan Fridman, Ciudad Autónoma de Buenos Aires, Argentina,  
dylanfridman@gmail.com

Ema Slavkova, Sofia, Bulgaria, emamatema@abv.bg

Emil Indzhev, Rouse, Bulgaria, emil.indjev@gmail.com

Galina Staneva, Varna, Bulgaria, gale.staneva@gmail.com

Hamish Attenborough, Queenstown, New Zealand,  
hamish.attenborough@gmail.com

Ivan D. Ivanov, Sofia, Bulgaria, ivan@vankata.tk

Ivan Georgiev, Sofia, Bulgaria, ivan.v.geo@gmail.com

Ivan Nikolov, Sofia, Bulgaria, ivannikolov007@gmail.com  
Ivan Todorov, Varna, Bulgaria, ivan.s.t@abv.bg  
Ivaylo Petrov, Stara Zagora, Bulgaria, ivko\_nz7@abv.bg  
Ivaylo Zhelev, Smolyan, Bulgaria, ivaylo\_jelev@abv.bg  
James Han Ju Lee, New Delhi, India, 18jlee@aes.ac.in  
Kaloyan Fachikov, Sofia, Bulgaria, kalo\_2002@abv.bg  
Kristian Spasov, Rouse, Bulgaria, kristianspasov@abv.bg  
Maksim Kasnedelchev, Rouse, Bulgaria, maxi01@mail.bg  
Maria Aleksandrova, Kardzhali, Bulgaria, mimeto6789@gmail.com  
Milen Ferev, Sofia, Bulgaria, m.ferev18@gmail.com  
Monika Velikova, Rouse, Bulgaria, moni\_bella@abv.bg  
Nikola Sekulov, Sofia, Bulgaria, nikolasekulov@gmail.com  
Nikola Staykov, Sofia, Bulgaria, nikola\_staykov@abv.bg  
Nikolaj Pashov, Sofia, Bulgaria, nikifaets11@gmail.com  
Nikolay Nikolov, Kardzhali, Bulgaria, nikolaynikolov.99@abv.bg  
Nogol Ramezani, Tehran, Iran, goli.ramezani@gmail.com  
Petyo Manev, Sofia, Bulgaria, petyo.manev@abv.bg  
Radoslav Dimitrov, Plovdiv, Bulgaria, radoslav192@gmail.com  
Shashank Rammoorthy, Bangalore, India, shashankr.blr@gmail.com  
Shreyash Gotmare, Andheri, Mumbai, India,  
shreyashg@hotmail.com



Siel Shefketova, Kardzhali, Bulgaria, sielrien1@gmail.com  
Stefan Genchev, Sofia, Bulgaria, stefan.genchev@sgsites.net  
Tanya Otsetarova, Plovdiv, Bulgaria, tanyaotsetarova@gmail.com  
Teodor Pavlov, Varna, Bulgaria, tosheca@icloud.com  
Thomas Hanson, Rangiora, New Zealand, tomh413@gmail.com  
Tsvetelina Karamfilova, Kardzhali, Bulgaria, cveti\_0620@abv.bg  
Vasilena Tsvetanova, Plovdiv, Bulgaria, vasi.tsvetanova@gmail.com  
Vesela Beshirova, Smolyan, Bulgaria, beshiriva@gmail.com  
Viktor Toporov, Rouse, Bulgaria, vikktortoporov@gmail.com  
Viktor Velev, Varna, Bulgaria, viktorvelev8@gmail.com  
Yangfanyu Yang, London, UK, yangyangfanyu@icloud.com  
Zhivko Kirishev, Plovdiv, Bulgaria, jivkokirishev@gmail.com  
Zvezdin Besarabov, Sofia, Bulgaria, business@zvezd.in





AMERICAN UNIVERSITY IN BULGARIA  
SCAPTOPARA CAMPUS - BLAGOEVGRAD



1. SCAPTOPARA RESIDENCE HALL 3
2. SCAPTOPARA RESIDENCE HALL 1
3. SCAPTOPARA RESIDENCE HALL 2
4. BALKANSKI ACADEMIC CENTER & LIBRARY
5. ABF STUDENT CENTER (ABF THEATRE, CANTEEN, CAFETERIA, GYM)



High School Student Institute  
of Mathematics and Informatics

**AMERICA FOR  
BULGARIA  
FOUNDATION**

**HSSIMI FOUNDERS:**



UNION OF  
BULGARIAN  
MATHEMATICIANS



EVRIKA FOUNDATION



INTERNATIONAL  
FOUNDATION  
ST. CYRIL AND  
ST. METHODIUS



INSTITUTE OF  
MATHEMATICS  
AND INFORMATICS



SUPPORTED BY THE  
AMERICAN  
FOUNDATION FOR  
BULGARIA

**HSSIMI gratefully acknowledges the support of:**

